PART #: NETB12WR

User Manual and Installation Guide

The WireRat™ (Part # NETB12WR) is designed for the monitoring of electrically driven pivots only. For hydraulically driven pivots, please refer to the user manual and installation guide for part # NETB12TL.

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Revision History

Rev	Date	Description
A	November 6th, 2012	Initial release of manual.
B	December 10th, 2012	Updated wiring diagrams.

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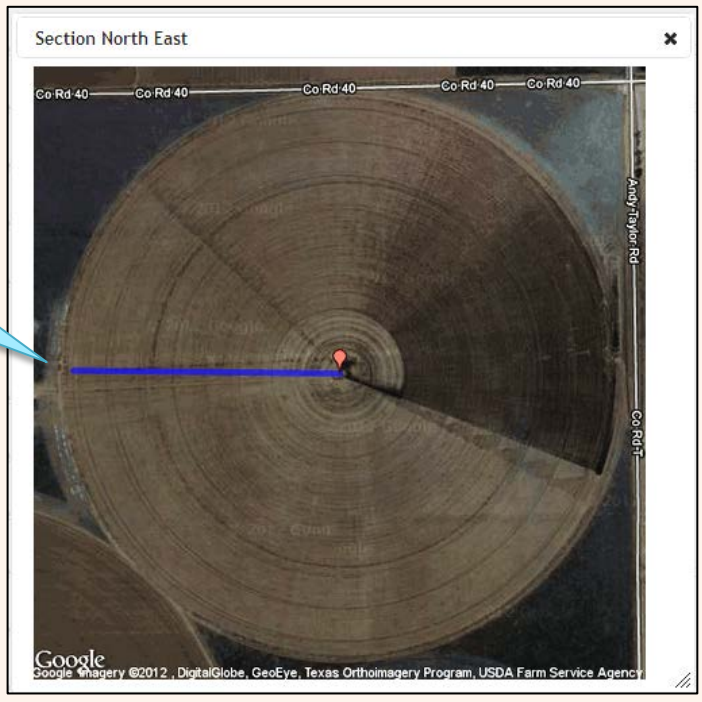
Applications

Part # NETB12WR (branded the WireRat™) is specifically designed to be mounted on the end tower of any brand of electrically driven center pivot. Once installed and properly configured, the NETB12WR provides the following remote monitoring functions:

Span Cable Theft Notifications	The NETB12WR is the only copper theft alarm product that works seamlessly with all brands of pivots and requires *no external power*. The NETB12WR utilizes a patent-pending supervisory circuit that works strictly on lithium battery power for 3 to 5 years. When a pivot's span cable is cut or tampered with, the NETB12WR sends instant text, voice, or email notifications that a possible theft is occurring.
Pivot Safety Stop Notifications	When a pivot transitions from walking to stopped, the NETB12WR can send text, voice, or email notifications that the pivot's safety circuit has opened.
Remote Shutdown	The NETB12WR contains a normally closed relay which can be wired in series with the pivot's safety circuit. Once configured, the normally closed relay can be actuated via a phone call to our interactive voice response system by calling 800-961-9549x7.
GPS Monitoring and Virtual Stop-In-Slot Notifications	The NETB12WR facilitates graphically monitoring the heading of a center pivot via a website. In addition, the NETB12WR can be used to provide *virtual stop-in-slot alerts* such that text, voice, email notifications, or remote shutdown commands are sent when a pivot reaches desired field headings.

Example: *The NETB12WR can send notifications or stop the pivot when the heading is at 270 degrees.*



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Getting Started

Identifying the Device Id

All NETB12 products are uniquely identified by a 6 digit serial number which is barcoded on both the packaging carton and the physical unit. Net Irrigate refers to this number as the “Device Id”.

Package Contents

All NETB12WR units ship with:

1. A ½” NPT Cord Grip to be used with the knock out on the pivot’s end tower box.
2. Magnetic mounts which come pre-installed on the enclosure.
3. A 24” heavy duty UV resistant nylon cable tie for safety-securing the unit.
4. A wire nut which may need to be used if wiring the NETB12WR up for remote shutdown purposes.
5. An extra *Device Id* bar code sticker which can be placed on the panel of the center pivot so the associated *Device Id* can be identified at the pivot pad.

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Bench Testing

The NETB12WR should be bench tested before being installed on an actual pivot. A simple bench testing procedure ensures a properly functioning unit and adequate wireless coverage. Bench testing involves the following procedure:

1. Identify the Device Id of the NETB12WR. Recall that the serial number is barcoded on the bottom of the unit to the right of the cord grip.
2. Use your cell phone to text the phrase "TEST XXXXXX" to **317-602-1732**. Where XXXXXX is the serial number of the unit. Example "**TEST 333001**".
3. You should receive a text message back from our server within 60 seconds that says: "*333001 is ready for bench testing. Hold White and GND wire together and then break bond. You will be notified in three minutes when test completes.*"
4. Follow the instructions texted to you by holding the White and GND (green) wires together and then breaking the circuit. This action will initiate a diagnostic test on the unit and will text you when complete. The entire test should take about 3 minutes.
5. Within 3 minutes, you should receive the text message: "*Bench test successful. Device 333001 is functioning properly and registered on the NetIrrigate network.*"
6. If you receive an error message from our server or do not receive a text message indicating success within 3 minutes, please contact customer support at (800) 961-9549 x2.

Customer, Site, and Notification Recipient Setup

Before mounting the NETB12WR on an actual pivot, it is best to setup the customer information, the irrigation site details, and the intended notification recipients in the NetIrrigate™ system. Additionally, you will need to link this information to the *Device Id* you intent to mount. Setup is fast and easy and can be accomplished through one of three possible ways:

1. Login to www.netirrigate.com. If you do not yet have a username and password for your dealership, please contact customer support at (800) 961-9549 or email support@netirrigate.com. For details on how to utilize the dealer portal on www.netirrigate.com, please review the document entitled "*Web Portal User Guide*".

2. Login to the WireRat™ iPhone App. WireRat™ is available in the App Store. You may use the same login information as you would use to login to www.netirrigate.com. For information on how to use the iPhone app, please review the document entitled "*WireRat™ iPhone App User Guide*".

3. If you do not have access to a computer or the WireRat™ iPhone App, just contact customer support at (800) 961-9549 and an agent will setup the customer, site, and notification recipients for you.

"Notification recipients" are the people who are contacted (either via voice call, text message, or email) when cable cut, safety-stop, or virtual stop-in-slot events occur at the pivot. Up to ten notification recipients can be configured per pivot. Notification recipients can be easily enabled or disabled by using the web portal, iPhone app, or simply by calling customer support at (800) 961-9549.

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Functional Principles

Battery Backup

The NETB12WR utilizes a custom designed lithium battery pack which is designed to operate the interval cellular radio modem for at least three years. Expected battery life could be as long as five years depending on environmental conditions and frequency of pivot operation. A working battery is imperative for proper functionality. The battery can be tested by following the bench testing procedures of the previous page.

Span Cable Theft Detection

The NETB12WR checks for cut wire by sending a small supervisory current through the neutral and ground conductors of the pivot's span cable. When this supervisory current is interrupted, an alarm code is triggered. The supervisory current is generated by the internal NETB12WR batteries and works seamlessly with normal pivot operation. For the span cable alarm to properly arm itself, at least 50,000 ohms of resistance must exist between the ground and neutral conductors when separated at the control transformer or outgoing side of the collector ring.

Safety Stop Alerts

The NETB12WR transmits safety stop notifications when it detects a *closed-to-open* transition in a pivot's 120VAC safety circuit. The NETB12WR must see the circuit open for at least 40 seconds before transmitting a wireless notification that the circuit transitioned from *closed-to-open*. The time delay is to prevent false alarms due to loose wires, pivot jogging, and auto-reverse functionality. On non-standard pivots, paralleling off of any 120VAC control circuit that is hot when the pivot is running (in both forward and reverse) will suffice in monitoring for safety stops.

Remote Shutdown

If the NETB12WR is wired correctly, it may be used to remotely stop a center pivot. Each NETB12WR is equipped with a *normally closed* control relay. When a remote shutdown call is initiated, the coil on this control relay is wirelessly picked up, thereby interrupting the normally closed safety circuit. When the NETB12WR senses the 120VAC supplied by the pivot panel has dropped out, the coil of the relay de-energizes, and the contact closes again thereby allowing the pivot to restart.

For remote shutdown functionality to properly work, the NETB12WR must remain ON until the pivot completely drops out. The NETB12WR must still receive 120VAC from the main pivot panel until the delay timer in the pivot drops out.

The remote-shutdown functionality utilizes the red wire in the NETB12WR connection cord. If wiring for remote shutdown is not desired, tape off the red wire and do not put the safety circuit in series with the NETB12WR. Instead, just parallel the black wire in the NETB12WR connection cord to the appropriate 120VAC safety circuit OR connect the black and blue wires to the respective forward and reverse terminals of the pivot. **To avoid shorts, be sure to properly tape or cap off the red wire on the NETB12WR if the unit is not being wired for remote shutdown purposes.**

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GPS Monitoring

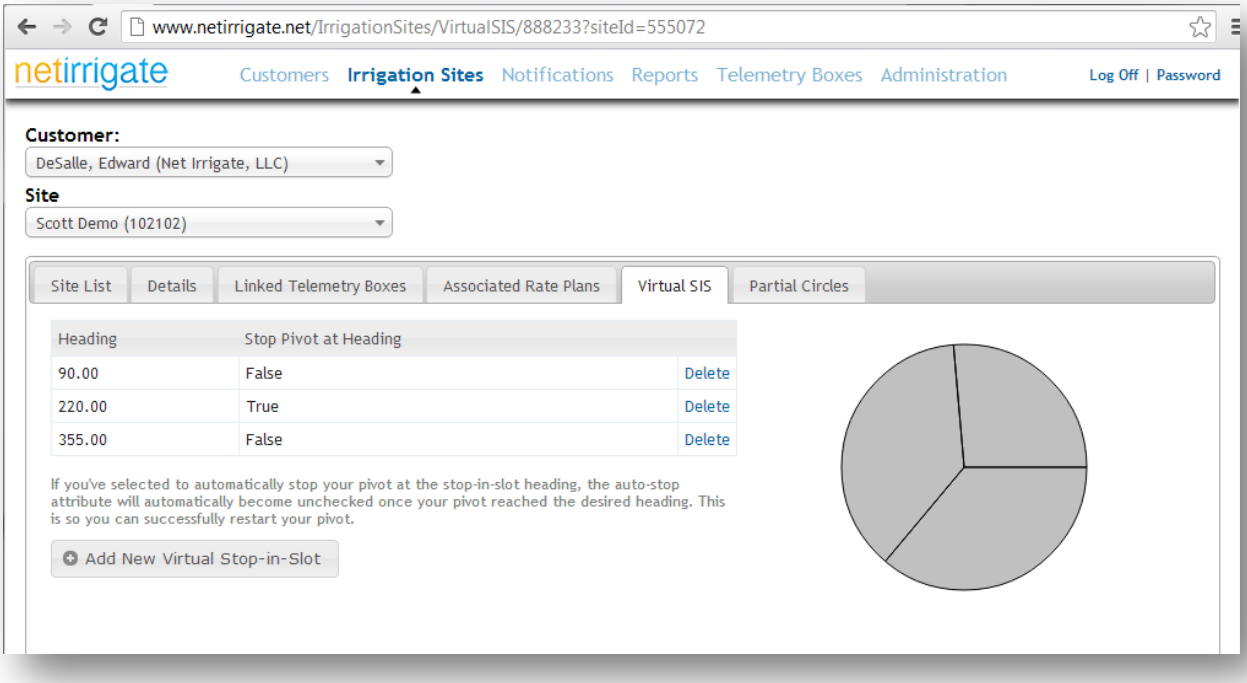
Pivot Heading

The NETB12WR sends longitude and latitude coordinates to the NetIrrigate® servers every 15 minutes. If the longitude and latitude coordinates of the pivot pad are properly entered as part of the site details, the software on the server will use basic trigonometry to determine the angle or "heading" of the pivot. Determining the longitude and latitude coordinates of the pivot pad can be accomplishes with several smart phone apps, most consumer GPS devices, or even the WireRat™ iPhone app. Alternatively, you may contact customer support at (800) 961-9549 and an agent will attempt to locate the pad of the pivot using Google Earth.

Virtual Stop-In-Slots

Because the NetIrrigate® servers are monitoring the heading of the pivot, notifications can be configured when the pivot reaches a desired a heading. Likewise, the pivot can be configured to automatically shut down when a desired heading is met. Up to 16 different virtual stop-in-slot points can be configured. Virtual stop-in-slot points can be configured via the NetIrrigate® web portal or by calling customer support at (800) 961-9549.

Sample Virtual Stop-In-Slot Configuration Screen on netirrigate.com



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Installation

Checking the Pivot

If the span cable theft alarm function of the NETB12WR will be utilized, it is best to confirm the resistance between the ground and neutral conductors on the pivot. Recall that the span cable alarm is activated when the bond between the neutral control circuit conductor and the equipment grounding conductor is broken.

1. Locate the control transformer in the pivot control panel. Remove the bonding wire (green) from terminal X2 on the control transformer. Re-tighten the terminal screw to hold the remaining neutral wires (white) in place on X2.

2. If the pivot is equipped with a modern relay board, disconnect the clip to the relay board that contains ground and neutral conductors.

3. Using an **analog ohmmeter**, measure the resistance between the bonding wire (green) and terminal X2 (white) on the control transformer. The measured resistance should be greater than 50k (50,000) ohms. If the measured resistance is greater than 50k ohms, replace the bonding wire (green) on terminal X2 of the control transformer and proceed to mounting the NETB12WR on the end tower of the pivot. *If the measured resistance is less than 50k ohms see Appendix F entitled "Common Causes of Low Ground Resistance".*

Mounting and Wiring the NETB12WR

Ideally, the NETTB11 should be mounted on the end tower of a pivot. This provides for greatest accuracy when utilizing GPS services. Likewise, mounting on the end tower provides for maximum protection against span cable theft.

1. **<u>Ensure power to the pivot is completely off and the control panel is locked.</u>**

2. Climb the tower of the pivot and allow the powerful magnets on the back of the NETB12WR to adhere to the angle iron of the pivot. The NETB12WR should be positioned vertically.

3. Remove the cover from the tower electrical box.

4. If the bottom of the tower box is not equipped with a standard ½" NPT knock-out, drill an appropriate hole to fit the black ½" NPT cord grip which is included in the NETB12WR packaging.

5. Install the supplied cord grip and lock nut.

6. Run the tray cable from the NETB12WR through the cord grip and into the tower box.

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7. Follow the appropriate wiring diagram depending on the brand of pivot. Refer to the tables below. If installing on a pivot brand not listed, please contact customer support at (800) 961-9549.

For setups WITHOUT implementation of remote-shutdown functionality						
		NETB12WR Wire Color				
		Black (120VAC In)	Blue (120VAC In)	Red (NC Relay Out – 120VAC)	White (Neutral)	Green (GND)
Pivot Brand Wire Color	Valley	Yellow-Red	Unused (Tape Off)	Unused (Tape Off)	White	Grounding Bar
	Zimmatic	Brown	Unused (Tape Off)	Unused (Tape Off)	White	Grounding Bar
	Reinke	Purple	Pink	Unused (Tape Off)	White	Grounding Bar
	Lockwood	Yellow	Orange	Unused (Tape Off)	White	Grounding Bar
	Pierce	Yellow	Unused	Unused (Tape Off)	White	Grounding Bar

For setups in which remote-shutdown functionality WILL be implemented, see wiring diagram in the respective Appendix listed below			
Pivot Brand	**Additional Relays Needed?**	**Appendix**	**Page #**
Valley	**No**	**A**	**15**
Zimmatic	**No**	**B**	**16**
Reinke	**Yes (only required for remote shutdown)**	**C**	**17**
Lockwood	**Yes (only required for remote shutdown)**	**D**	**18**
Pierce	**No**	**E**	**19**

8. Once the NETB12WR wires are connected to the appropriate terminals, replace the cover on the tower box.
9. If necessary, zip-tie the NETB12WR tray cable away from the mechanical levels beneath the tower electrical box to avoid kinks or obstructions.
10. Wrap the included 24” heavy duty UV resistant nylon cable tie around the NETB12WR unit for added security. While the mounting magnets are extremely strong, the cable tie is designed to protect against extremely severe weather.

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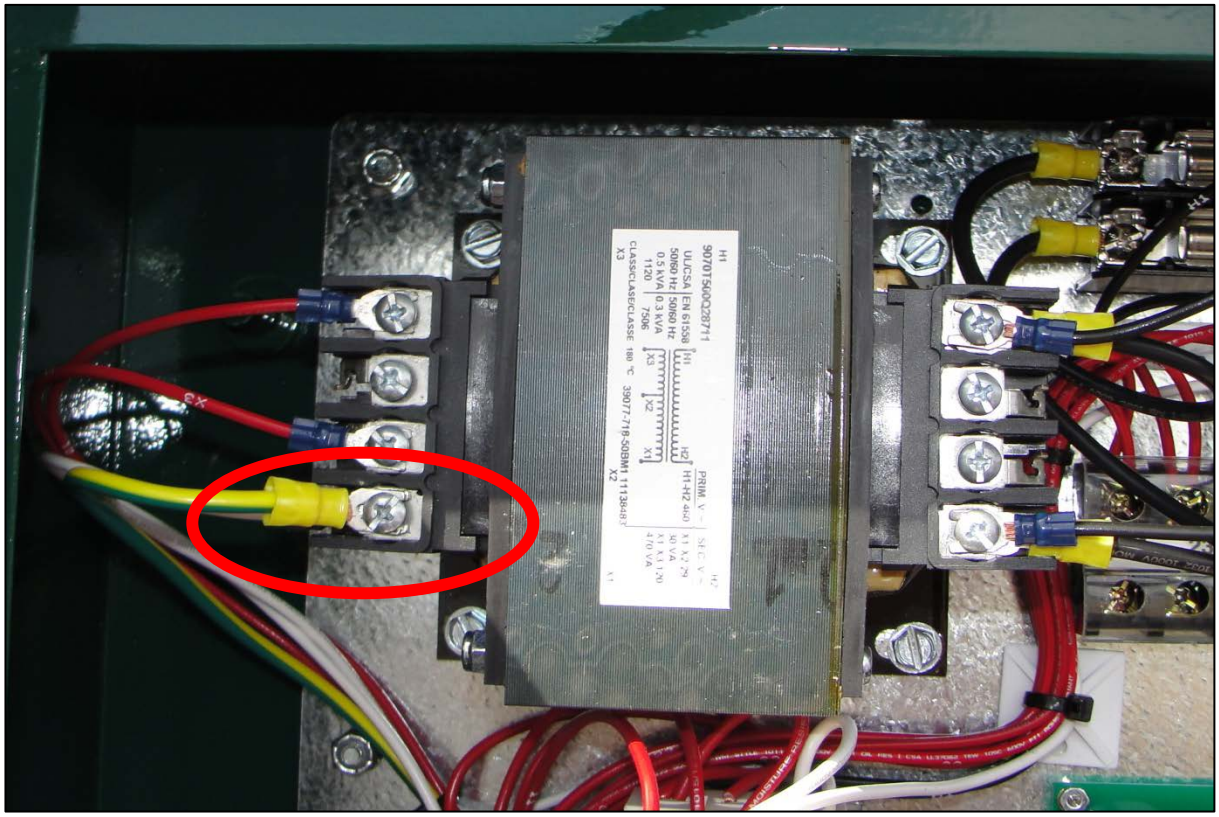
Testing Procedures

Simulating Span Cable Cuts

Before testing the cut wire alarm, at least one notification recipient should be configured for the site in question. If this has not been done, please see previous section Customer, Site, and Notification Recipient Setup. Once it is determined that a notification has been configured for a span cable cut event, follow the procedure below:

Primary Method

1. Go to the main panel at the pad and **ensure the power to the panel is completely off**.
2. Open both panel doors such that the control transformer within the pivot panel can be accessed.
3. If the pivot panel is equipped with a relay board, disconnect the clip to the relay board which may contain a neutral and ground conductor.
4. Locate X-2 on the control transformer. This is where the white and green wires are bonded.
5. Remove the terminal screw and separate the white wire and the ground wire for at least 5 seconds.
6. Replace the wires and be sure to re-tighten the terminal screw.
7. Wait at least 3 minutes for a text, voice, or email alert which indicates a possible theft is occurring. If an alert is not received, try testing with the alternative method on the following page.



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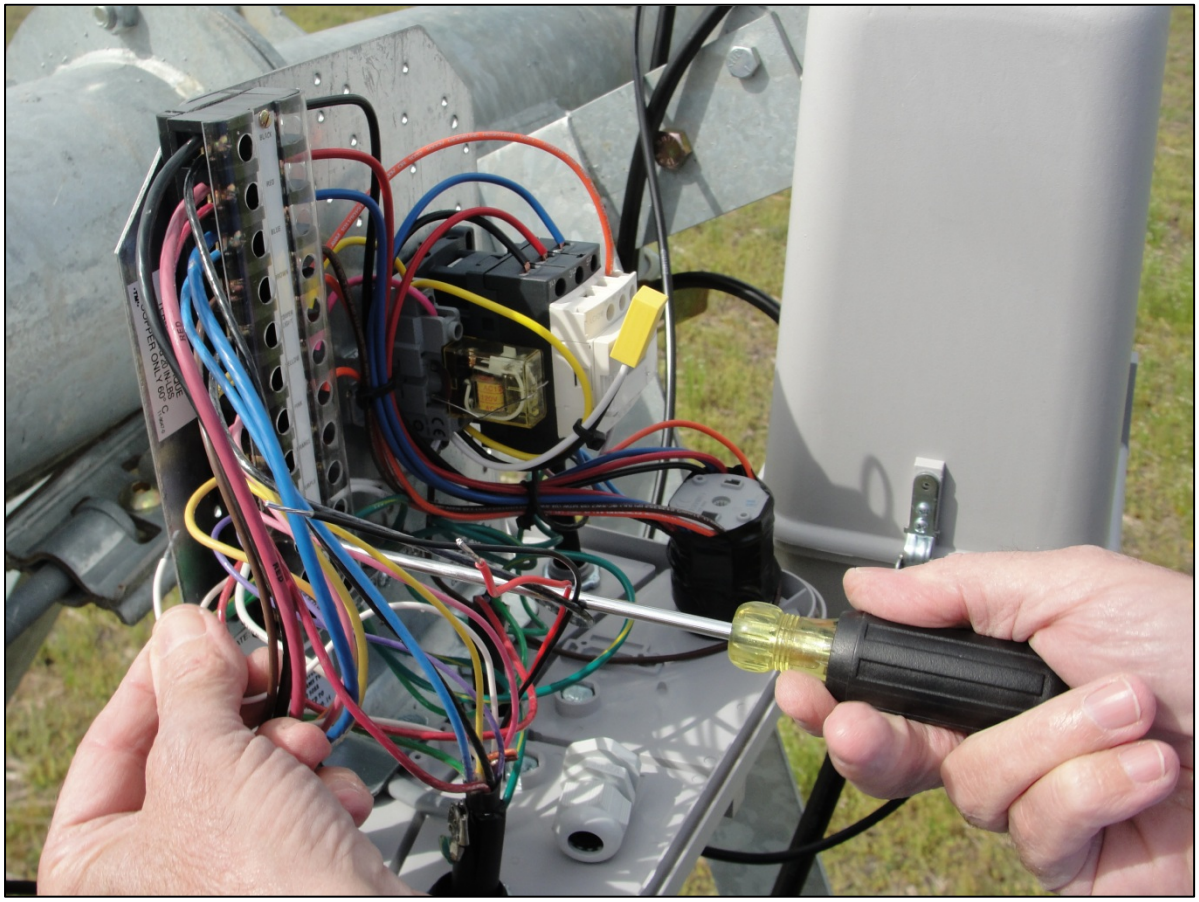
Alternative Method

1. **Ensure power to the pivot is off and the control panel is locked**.
2. Walk to the first drive tower, climb it, and remove the tower box cover.
3. Note the terminal numbers of where each wire is connected. There are two gauges of wire in the tower box. The smaller wire is what you will be working with. The span cable heading out toward the end tower is what will need to be disconnected sequentially.
4. Remove each 120VAC control circuit wire. This includes: safety, forward, reverse, percent timer, and end gun. **REMOVE THE WHITE NEUTRAL CONDUCTOR LAST**.
5. Wait at least 30 seconds and replace the wires to their respective terminals.
6. Replace the tower box cover.
7. Wait at least 3 minutes for a text, voice, or email alert which indicates a possible theft is occurring. If an alert is not received please contact customer support at (800) 961-9549.



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Testing Safety Stop Notifications

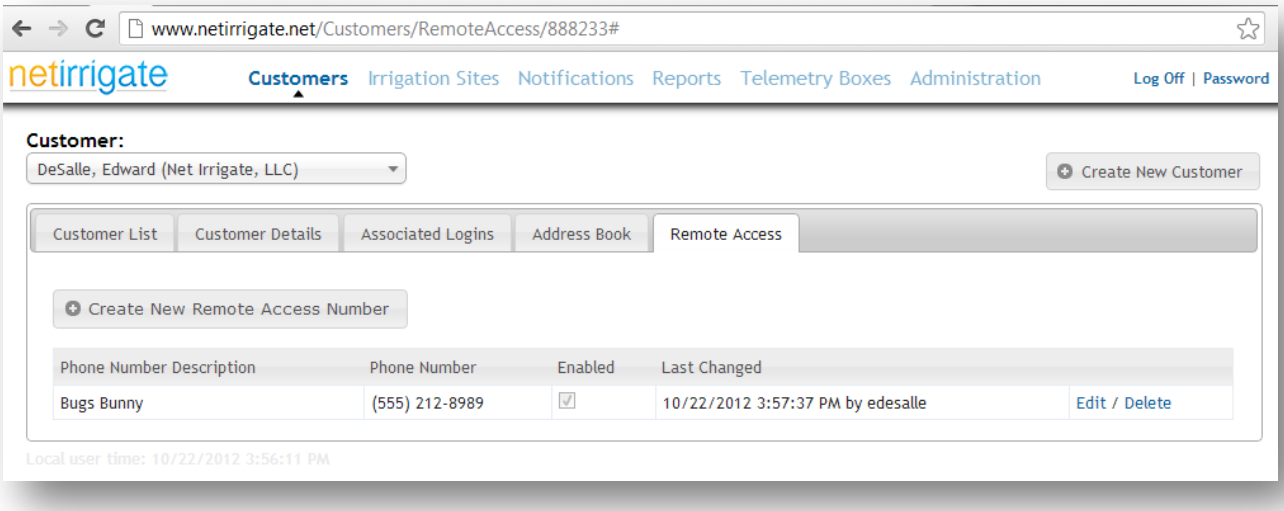
Before testing for safety stop notifications, at least one notification recipient should be configured for the site in question. If this has not been done, please see previous section Customer, Site, and Notification Recipient Setup.

If desired, safety stop notifications can be configured for when the pivot both starts up and stops walking. Once it is determined that notification recipients have been configured for each respective alert, follow the procedure below:

1. Start the pivot walking in either forward or reverse.
2. In about three minutes, you should receive a message that says "*{NetIrrigate Site Name} is now running.*" Where *{NetIrrigate Site Name}* is the alias you've given to the irrigation site.
3. Once you receive the notification that the system is running, stop the pivot.
4. Within three minutes, you should receive a message that says "*{NetIrrigate Site Name} has stopped walking."*
5. Repeat the process by walking the pivot in the opposite direction. To ensure proper functionality, **it is important to walk the pivot in BOTH directions**.
6. If any of the notifications fail, please contact customer support at (800) 961-9549.

Testing Remote Shutdown

Remotely shutting down the pivot is accomplished through the NetIrrigate® Remote Shutdown Line. The NetIrrigate® Remote Shutdown Line uses caller id security to identify your list of pivots available for remote shutdown. To enable your phone to initiate remote shutdown calls, make sure your phone number exists and is enabled within the Remote Access tab within the NetIrrigate® Web Portal.



To initiate a remote shutdown call, **simply dial (800) 961-9549 x7**. The automated system will read off a list of your pivots available for remote shutdown. Follow the voice prompts and your pivot should shut down within two minutes. You will receive a safety stop notification if remote shutdown is successful.

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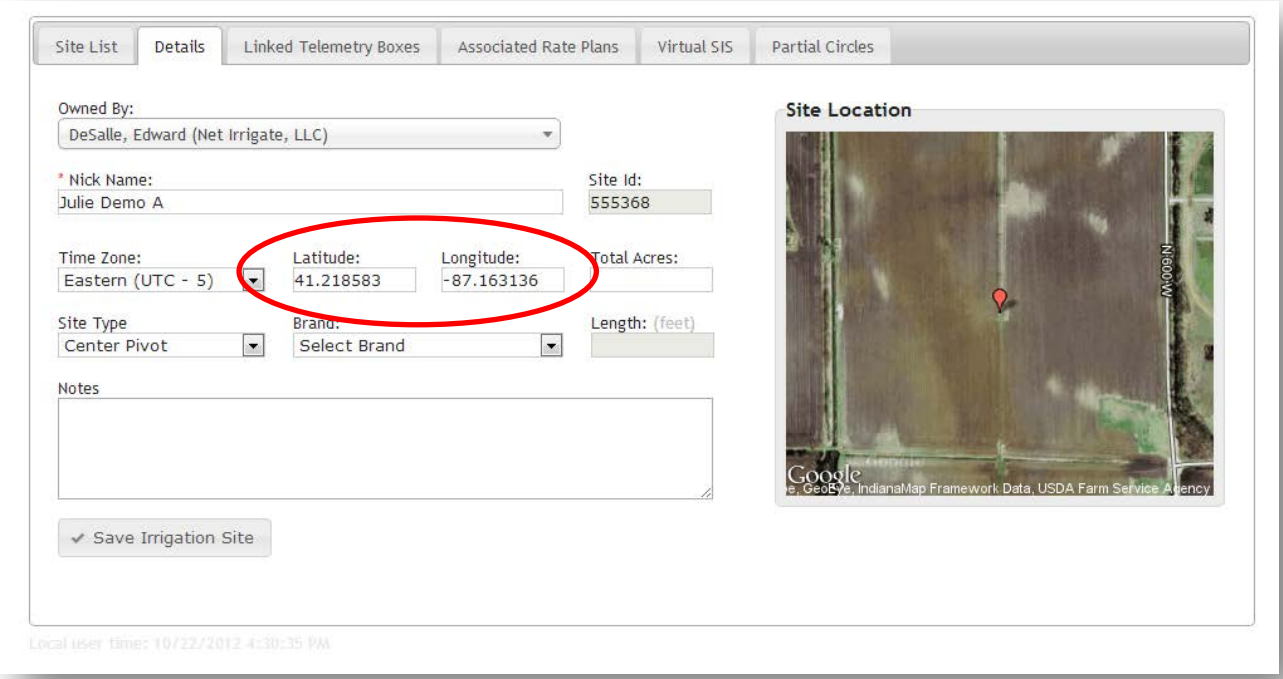
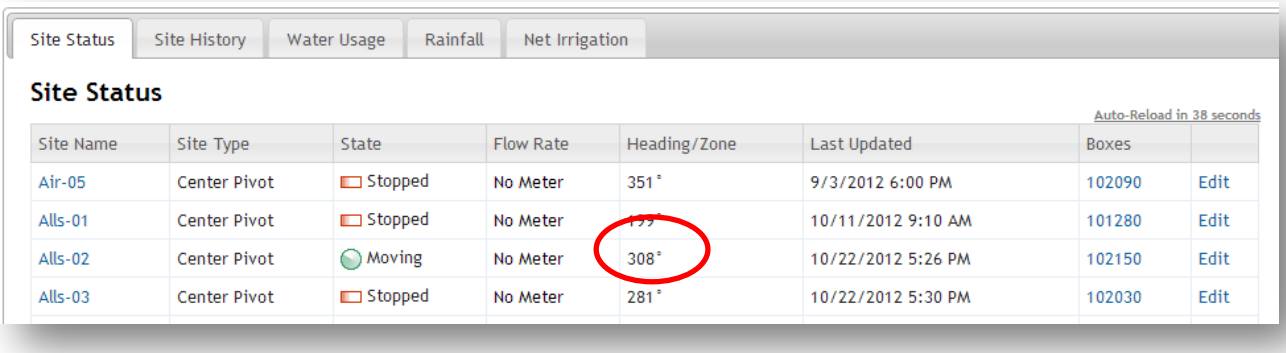
Testing GPS

Successful GPS monitoring begins by ensuring the latitude and longitude of the pivot pad have been entered into the NetIrrigate® servers. The latitude and longitude of the pad may either be entered via the WireRat™ iPhone app or via the site details tab in the NetIrrigate® web portal:



To acquire an initial pivot heading, **run the pivot for at least 15 minutes**. Once a GPS fix is established, the pivot heading should update on the Site Status report within the NetIrrigate® web portal.
If a virtual stop-in-slot alert is configured, the notification will trigger when the pivot is within 3 degrees of either side of the configured heading. For example, if a virtual stop-in-slot notification is configured at 90°, the stop-in-slot notification will occur when the NETB12WR periodically reports latitude and longitude which results in the heading of the pivot to be between 87° and 93°. The tolerance window is designed to compensate for the wide variance in pivot speeds and percent timer settings.


Site Status
Site History
Water Usage
Rainfall
Net Irrigation
Site Status
Auto-Reload in 38 seconds
Site Name | Site Type | State | Flow Rate | Heading/Zone | Last Updated | Boxes
Air-05 | Center Pivot | Stopped | No Meter | 351° | 9/3/2012 6:00 PM | 102090 | Edit
Alls-01 | Center Pivot | Stopped | No Meter | 199° | 10/11/2012 9:10 AM | 101280 | Edit
Alls-02 | Center Pivot | Moving | No Meter | 308° | 10/22/2012 5:26 PM | 102150 | Edit
Alls-03 | Center Pivot | Stopped | No Meter | 281° | 10/22/2012 5:30 PM | 102030 | Edit

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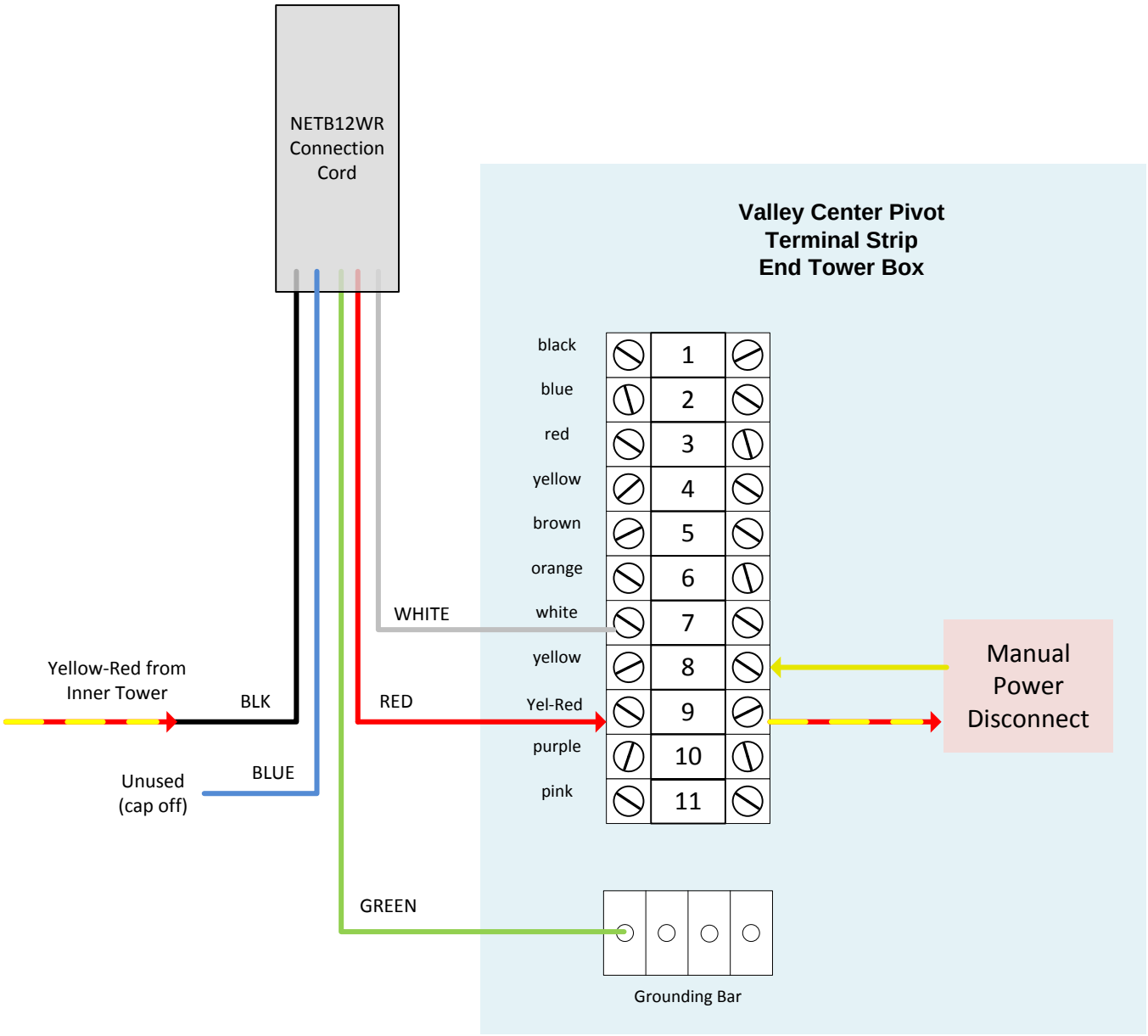
Appendix A – Valley Branded Pivots Wiring Diagram

1. Remove the yellow-red wire from the load side of the terminal strip.
2. Connect the red wire from the NETB12WR to terminal 9 where the yellow-red wire was.
3. Wire-nut the removed yellow-red wire to the black wire on the NETB12WR.
4. Connect the white wire on the NETB12WR to terminal 7 (neutral).
5. Connect the green wire on the NEB12WR to Ground.
6. The blue wire on the NETB12WR is unused and should be taped off.



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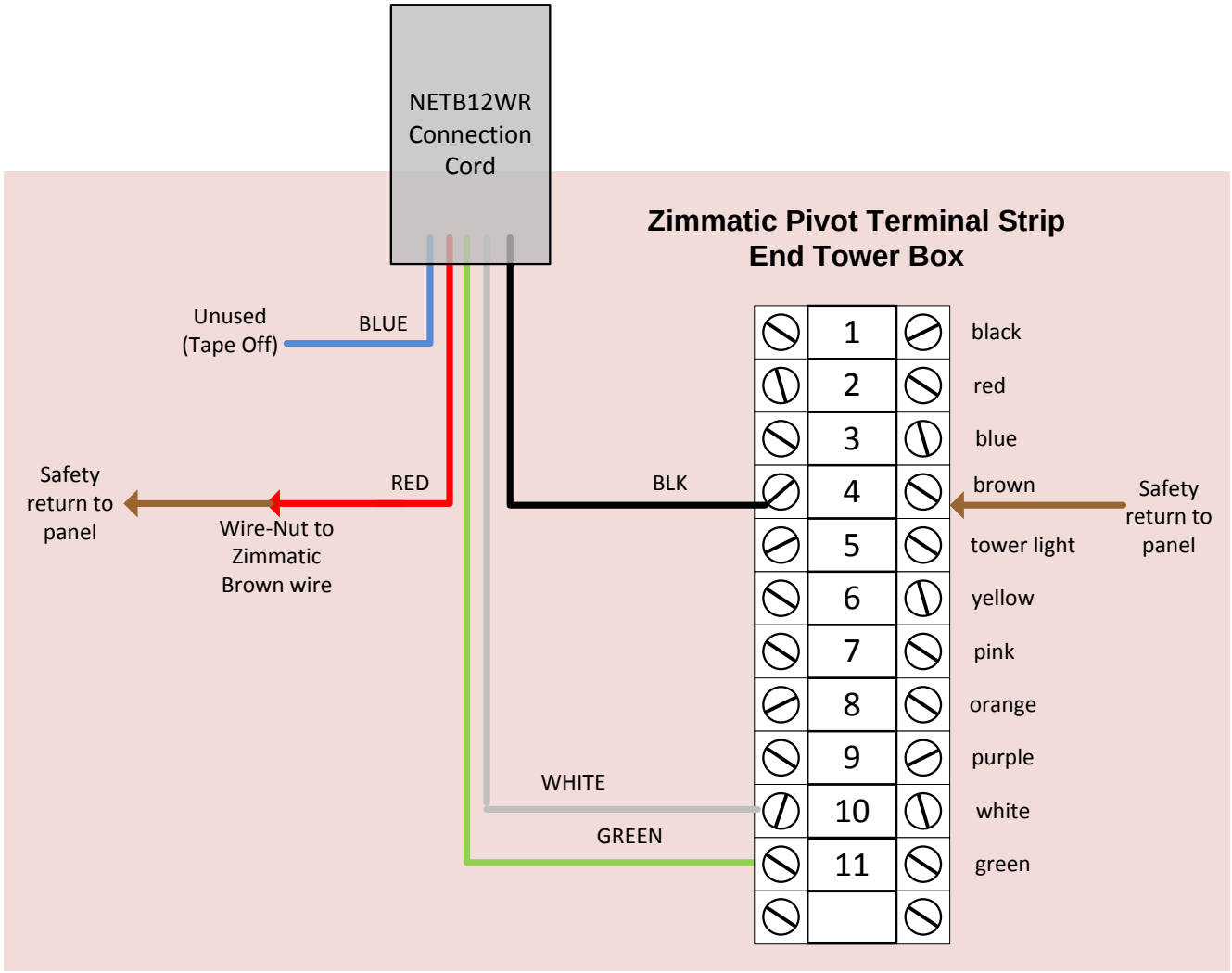
Appendix B – Zimmatic Branded Pivots Wiring Diagram

1. Remove the brown wire that is heading in the direction of the pivot pad from terminal 4.
2. Connect the black wire from the NETB12WR to terminal 4 where the brown wire was.
3. Wire-nut the removed brown wire to the red wire on the NETB12WR.
4. Connect the white wire on the NETB12WR to terminal 10 (neutral).
5. Connect the green wire on the NETB12WR to Ground.
6. The blue wire on the NETB12WR is unused.



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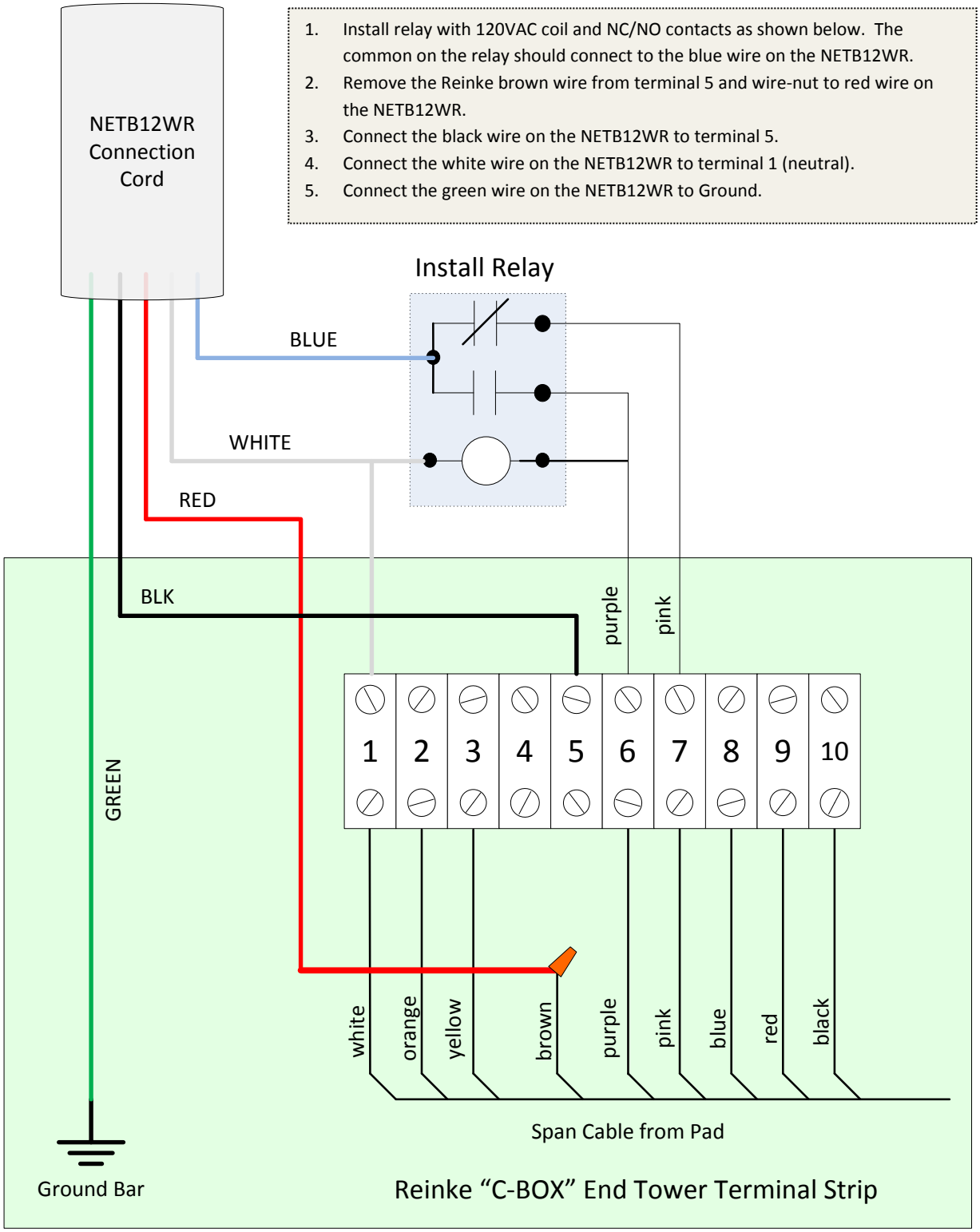
Appendix C – Reinke Branded Pivots Wiring Diagram



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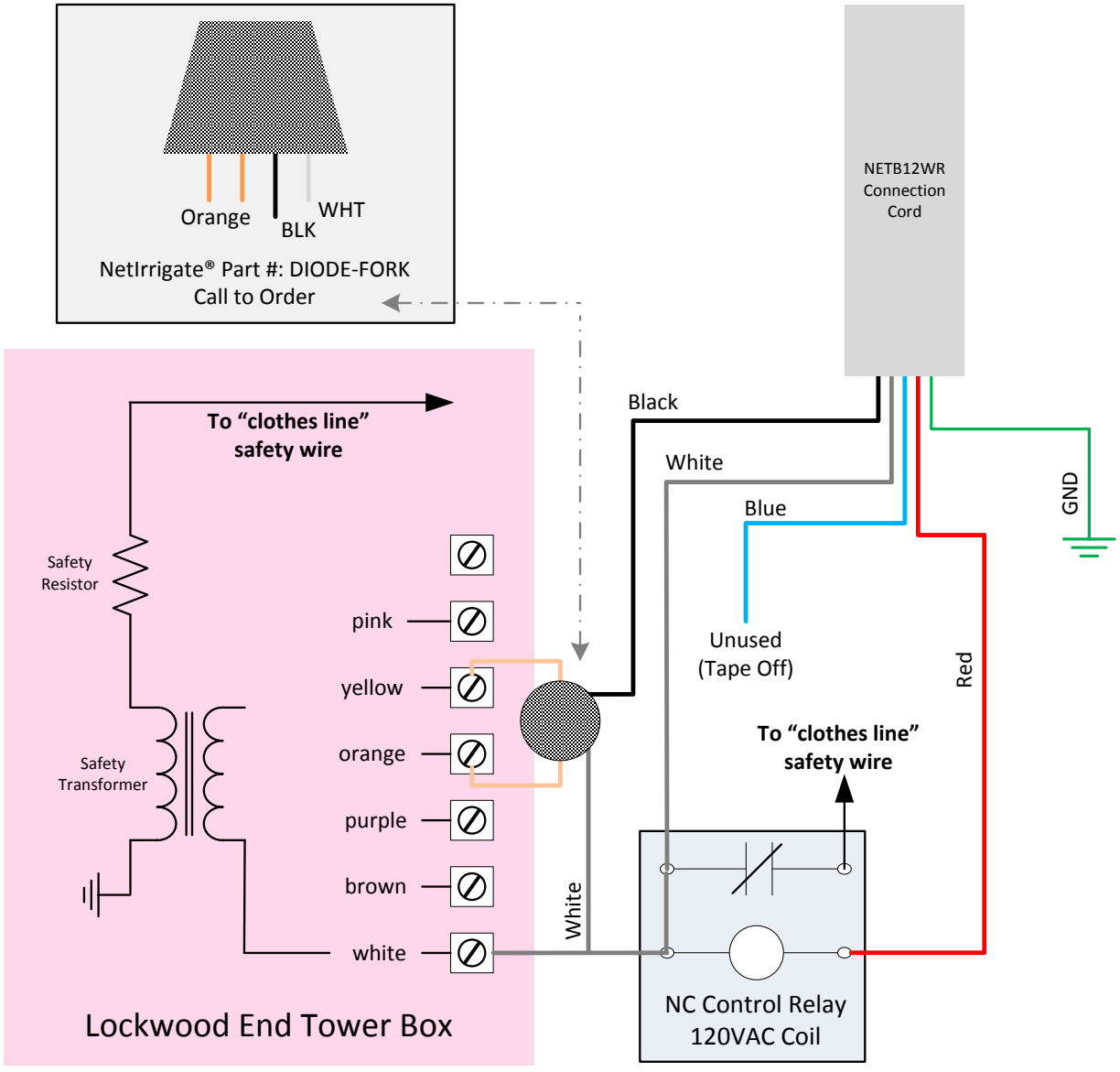
Appendix D – Lockwood Pivots Wiring Diagram

1. Install the NetIrrigate® DIODE-FORK on the forward and reverse control circuit terminals. The orange wires on the DIODE-FORK should be attached to these terminals.
2. Connect the Blue wire on the DIODE-FORK to the Black wire on the NETB12WR.
3. Connect the White wire on the DIODE-FORK to any neutral terminal.
4. Install a control relay with NC contacts and a 120VAC coil as shown below.
5. Note that shorting neutral to the "clothes-line" on a Lockwood pivot will cause it to stop. The NETB12WR will hold the short OPEN while the pivot is running in forward or reverse. An incoming remote shutdown command will drop-out the AC Line on the red wire closing the contact between neutral and the "clothes-line".
6. The blue wire on the NETB12WR is unused. Tape or cap off.
7. Connect the green wire on the NETB12WR to GND.



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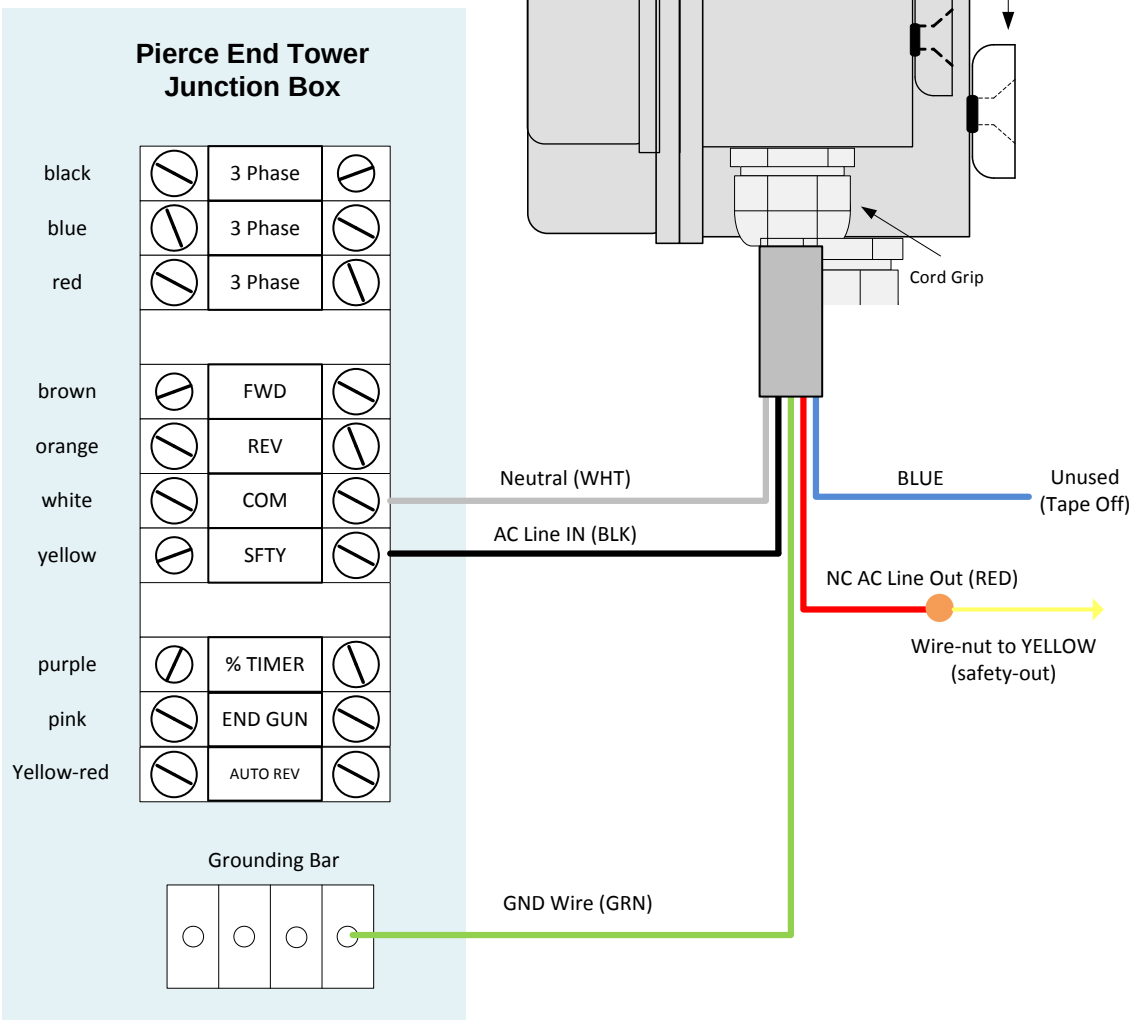
Appendix E – Pierce Branded Pivots Wiring Diagram

1. Remove yellow wire from outgoing side of the safety-out terminal and connect the black wire on the NETB12WR to the terminal instead.
2. Wire-nut the removed yellow wire to the red wire on the NETB12WR.
3. Connect the white wire on the NETB12WR to terminal 7 (neutral).
4. Connect the green wire on the NEB12WR to GND.
5. The blue wire on the NETB12WR is unused.



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Appendix F – Common Causes of Low Ground Resistance

Three different types of digital multi-meters were field tested for measuring span cable resistance. All three digital meters gave erroneous readings. We assume that the capacitance between the span cable shield and the span cable conductors produce unreliable digital meter readings. The WireRat™ span cable alarm will function if the 'open' circuit resistance is 50,000 ohms or higher. If the 'open' circuit resistance is lower than 50K ohms locating the source of the grounds can be both difficult and time consuming. Some of the most likely causes of low ground resistance measurements are as follows:

I. Running Lights

a. Flexible cords to the running lights are cracked and water logged.
b. Running light lamp sockets are deteriorated and leak to ground.

II. Collector Rings

a. Corrosion and debris on brush holders.
b. Corrosion and deterioration on shaft assembly.

III. Causes Specific to Valley Branded Pivots

a. **Tower Boxes**
    i. The neutral wire that supplies the relay coil circuit chaffs on the sharp edge of the relay back plate. Newer tower boxes have a nylon cable strap to prevent chaffing.
    ii. Moisture, corrosion and debris build up on the terminals of the micro-switches mounted to the bottom plate of the tower box.
b. **Neutrals -** *although the alarm connects to the neutral wire (white) of the span cable, most of the other conductors in the cable become part of the supervisory circuit.*
    i. At each intermediate tower box the neutral (white) is connected to the forward and reverse conductors (brown, orange) through each motor contactor relay coil and micro-switch (600 ohms).
    ii. The de-watering timer at the second to last tower connects the neutral wire (white) to the safety out (yellow-red), and safety return (yellow) through the timer clock motor (1200 ohms).
    iii. The percent timer (purple) is connected to the neutral through the relay coil in the end tower (600 ohms).
    iv. The end gun circuit (pink) is connected to the neutral through the solenoid coils.
c. **Corner Arms -** depending on methodology at install time, certain Valley branded corner arm pivots may require an isolation relay in the end tower to disconnect the neutral conductor from the corner arm when the pivot is off. The relay coil can be supplied by safety out (yellow-red). If an isolation relay is not used the span cable to the corner arm will not be protected by the span cable alarm.

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Appendix G – Troubleshooting False Alarms

False alarms may be triggered when the circuit resistance between the span cable neutral conductor (white) and the span cable ground conductor (green) rapidly increases to more than 50K ohms. Large changes in circuit resistance CAN be tolerated without triggering the alarm. For example:

- Abrupt changes in circuit resistance from near 0 ohms to 20K ohms *will not* trigger the alarm. The circuit resistance can repeatedly be changed from 0 ohms to 20K ohms without triggering the alarm.
- Gradual changes in circuit resistance from near 0 ohms to 50K ohms *will not* trigger the alarm.

Symptom	Probable Cause and Remedy
False alarms repeatedly are generated while the pivot is running in either direction	• AC Line is not connected to the black conductor on the NETB12WR connection cord. The AC Line can usually be tapped off the pivot's 120VAC safety circuit. See appropriate wiring diagram.
False alarms occur repeatedly only when pivot is running in one direction	• Diode fork faulty or improperly installed. • Blue wire on NETB12WR not connected to REV • Black wire on NETB12WR not connected to FWD
False alarms randomly occur when pivot is sitting idle	• Dirty collector ring (most common on Zimmatic pivots). Clean collector ring with emery cloth. • Corroded rotary brush assembly at collector ring. Install a 2000 ohm 5 watt resistor between the neutral conductor and ground conductor across the outbound span cables at the collector ring. • Loose connection on ground or neutral terminals in tower boxes. This may occur due to deteriorating span cable cord grips on tower boxes.
False alarms occur on pivot start-up only	• Barricade stop is holding safety circuit open longer than expected, thus NETB12WR cannot see AC Line signal until pivot moves completely off the barricade. Rewire to junction box before barricade stop switch. • Barricade stop switch is opening neutral conductor. • Transient voltage spikes from generator. Leave pivot panel in the OFF position while starting up generator.
False alarms when pivot stops	• Loose neutral or ground on pivot. • NETB12WR box not securely mounted and rattling.

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